

Headquarters U.S. Air Force

Integrity - Service - Excellence

Air Force Technologies



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Overview

- **New defense strategy - changing demand signals**
- **Technologies for the future**
 - Directed energy
 - High speed weapons
 - Alternative to GPS navigation
 - Propulsion
 - Autonomy
 - Cyber



Air Force S&T Vision:

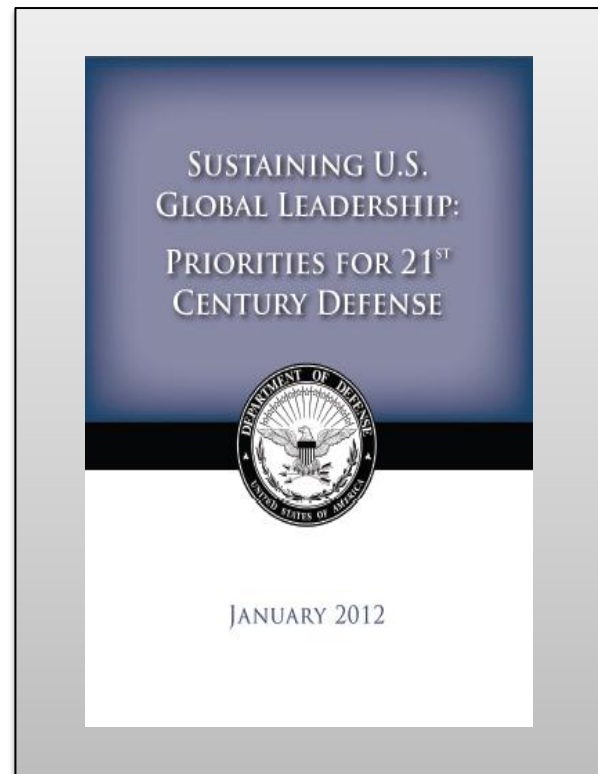
Create compelling air, space, and cyber capabilities for precise and reliable Global Vigilance, Reach and Power for our Nation



Defense Strategic Guidance

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- Transition from an emphasis on today's wars to preparing for future challenges
- Continue to contribute to security globally; rebalance toward the Asia-Pacific region
- Project power in areas in which U.S. access and freedom to operate are challenged by asymmetric means
- Invest in capabilities to defend networks, operational capability, and resiliency in cyberspace and space
- Develop innovative, low-cost, and small-footprint approaches to achieve security objectives



“As we end today’s wars and reshape our Armed Forces, we will ensure that our military is agile, flexible and ready for a full range of contingencies.”

- From “Sustaining U.S. Global Leadership: Priorities for 21st Century Defense”



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Counter-Electronic High Power Microwave (HPM) Advanced Missile Project (CHAMP)

- **HPM payload integrated into an aerial vehicle**
- **Multi-shot and multi-target aerial demonstration system capable of disabling, degrading, or damaging an adversary's electronic systems**
- **CHAMP was successfully flight tested on 16 October 2012**
 - **During the flight test, the CHAMP cruise missile navigated a pre-programmed flight plan and emitted bursts of high-powered microwaves at targets containing a wide range of representative electronic equipment, effectively delivering a functional disable of the systems**
 - **The RF pulse has no harmful effect on people or structures in and around the target area**
- **CHAMP will provide combatant commanders with a non-kinetic counter electronics capability as a complement to lethal measures, increasing mission options for the warfighter**





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Hypersonic Technologies – High Speed Strike Weapon (HSSW)

- **Hypersonic technologies can increase weapon survivability and improve response time to prosecute time sensitive targets in heavily defended environments from safe standoff ranges**
 - **Smaller force structure / force multiplier**
 - **Complete missions with fewer weapons and platforms**
- **S & T efforts to develop and demonstrate tactically-relevant long range HSSW and mature technologies for potential follow-on acquisition program**
 - **Tactically-relevant scramjet propulsion implementation**
 - **Lightweight high temp structures**
 - **Tailored blast pulse to maximize target coupling**





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Navigation Alternatives to GPS

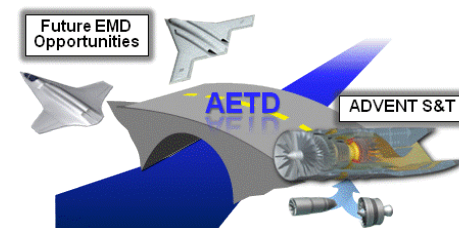
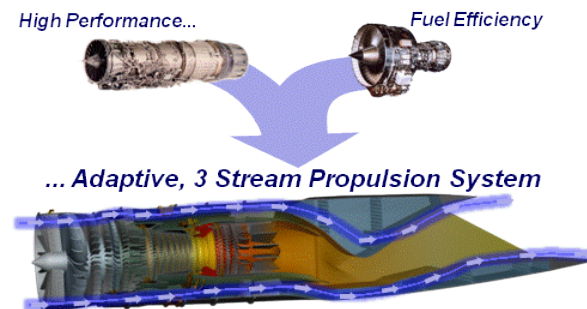
- Extensive reliance on GPS is a vulnerability in A2/AD environment
- Enable precise positioning, navigation, and timekeeping (PNT) for flight, SA, ISR, geo-registration and effects delivery when GPS is degraded and/or denied
- Improved nav capabilities
 - Strategic grade IMU
 - Cold Atom Technology – future capability for atomic clocks, reduced size/weight
- Improved ability to update via external signals or measurements
 - Vision-based: leverage existing EO/IR sensors with planned landmarks, imagery, databases
 - Celestial aided inertial navigation



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Propulsion – Adaptive Turbine Engines

- Adaptive engine technology enables 25% reduction in fuel consumption
 - Increases persistence
 - Reduces tanker demand
 - Potential for long-range supercruise and improved survivability
- Adaptive Versatile Engine Technology (ADVENT)
 - New engine architecture for optimal operation
 - Design and test components such as adaptive fan
- Adaptive Engine Technology Development (AETD)
 - Mature ADVENT technologies for follow-on activities
 - Inlet and exhaust integration for multiple platforms
 - Power and thermal management





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Autonomy: Machine Intelligence for Mission-Focused Autonomy

- **Autonomy addresses information overload**
 - **Prevents missing key intelligence in big data sets**
- **Will lead to more efficient use of manpower**
 - **Potential to reduce manpower requirements by 1-2 orders of magnitude**
- **Activities/Challenges:**
 - **Agent-based data mining and learning for large, complex data types, features, and independent actors**
 - **Enable decentralized and dynamically-centralized problem solving for information collection and decision support**
 - **Enable new scales of autonomy: thousands of agents operating collectively**

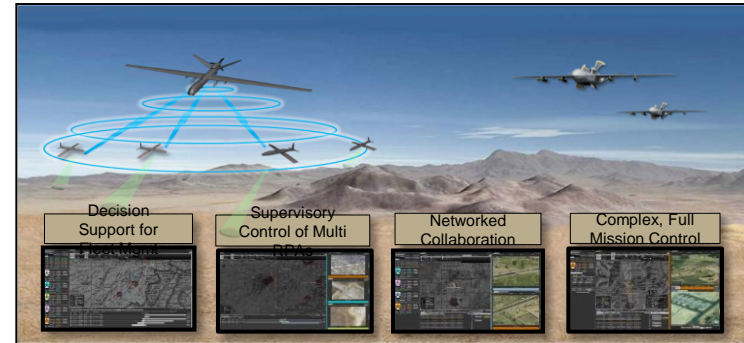




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Autonomy: Control for Vehicles and Weapons

- **Autonomous systems can achieve mission goals with many systems controlled by few operators**
 - Improve operator concentration
 - Reduce asset losses
 - Increase manpower efficiency
- **Remotely piloted aircraft (RPA)**
 - Develop and demonstrate advanced multi-role control station, configurable for multi-aircraft transit, tactical missions, fleet management
 - Utilize flexible automation tools to enable fewer operators to simultaneously control more RPAs/payloads across diverse, advanced missions
- **Weapons**
 - Large stand-off / fast engagement timelines in denied environment
 - Multi-role weapons that meet operational intent even as target, obstacle, non-combatants change

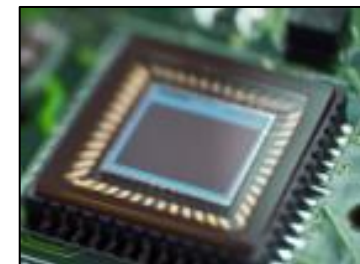
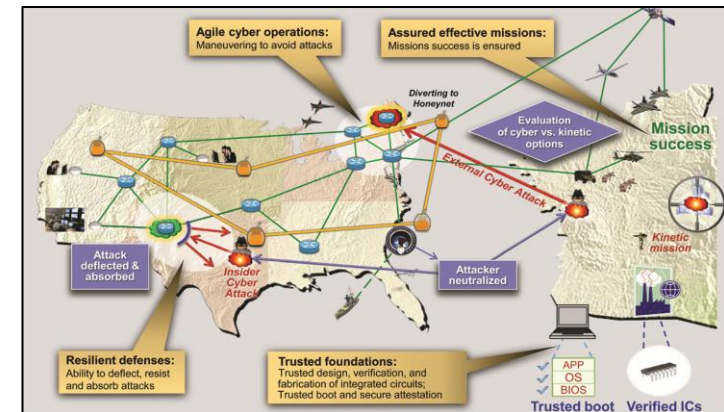




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Cyber Survivability and Recovery

- Must fight through attacks and maintain Mission Essential Functions (MEFs) in a contested cyber environment
- Air Force Research Laboratory S&T efforts are developing:
 - Techniques to disrupt/deny adversary attack planning
 - Trusted hardware
 - Formal tools, genetic programming, and system diversity





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Summary

- **Changing demand signal**
- **Long range weapon systems**
 - Enabled by advanced propulsion – high efficiency, high speed
- **Changing technologies in autonomy, directed energy, cyber, and navigation without GPS**

